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Indian Standard

MACROSCOPIC METHODS FOR DETERMINATION OF NON-METALLIC INCLUSION CONTENTS IN WROUGHT STEELS

PART 2 STEP MACHINED TEST METHOD

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MACROSCOPIC METHODS FOR DETERMINATION OF NON-METALLIC INCLUSION CONTENTS IN WROUGHT STEELS

PART 2 STEP MACHINED TEST METHOD

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PART 2 STEP MACHINED TEST METHOD

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Indian Standards Institution on 10 October 1983, after the draft finalized by the Metallography and Heat Treatment Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard has been prepared to provide a method for evaluating and expressing the size and distribution of non-metallic inclusions in wrought steel products by macrosopic methods. These methods deal with determination of non-metallic inclusions visible to the naked eye or with the aid of a magnifying glass with magnification of not more than 10×.

0.3 This standard is being issued in three parts consisting of three different macroscopic methods, generally used for the determination of non-metallic inclusions. This part covers the step machined test method of evaluating and expressing the total number and distribution of non metallic inclusions. The other two methods have been covered in the following parts:

Part 1 Blue fracture test method

Part 3 Magnetic particle inspection method

0.4 In this standard only those inclusions which are equal to or greater than 1 mm in length and 0·1 mm thick are taken into consideration. The parameters characterising the non-metallic inclusions shall be their total number and their length and/or thickness. No distinction is made in this standard between type of inclusions.

0.5 In the preparation of this standard, assistance has been derived from the following publications:

ISO 3763-1976 Wrought steels — Macroscopic methods for assessing the content of non-metallic inclusions. International Organization for Standardization.

SIS 111110 Methods for assessing the slag inclusion content in steels — Macroscopic methods. Swedish Standards Institution.

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS:2-1960*.

1. SCOPE

1.1 This standard (Part 2) prescribes the step machined test method for determining the total number and the distribution of non-metallic inclusions revealed by machining and visible on the longitudinal surfaces of a cylindrical stepped test piece.

2. FIELD OF APPLICATION

2.1 The test is applicable to rolled and forged products of simple shape. The test piece is generally machined from samples of bars or billets.

3. SAMPLING

3.1 The number of test pieces and their location shall be subject to agreement between the parties concerned.

4. TEST PIECE

4.1 According to the type of product and the purposes of the examination, the cylindrical test piece shall contain one or more concentric steps. Products with non-circular sections may be forged into the round bars before hand.

4.2 The test piece in common usage comprises three steps the dimensions of which are as given in Table 1 (*see* Fig. 1).

TABLE 1 DIMENSIONS OF STEPS OF TEST PIECE

STEP	DIAMETER	LENGTH mm
1	0·90 *D*	60
2	0·75 *D*	72
3	0·60 *D*	90

D = diameter or side of the product.

*Rules for rounding off numerical values (*revised*).

4.3 In the test piece dimensioned as in Table 1, the lengths of the steps are such that the surface area of each step is identical. Other dimensions of steps may be used subject to agreement between the parties concerned.

4.4 The test piece shall be carefully centred. Where it is necessary to have a greater area for examination, each step shall be machined successively along the whole length of the test piece, after establishing the number of inclusions for each step.

4.5 The test piece shall be turned so that the depth of the last cut is less than 0·2 mm. The machined surface shall be smooth and shall not show a relief which is too pronounced.

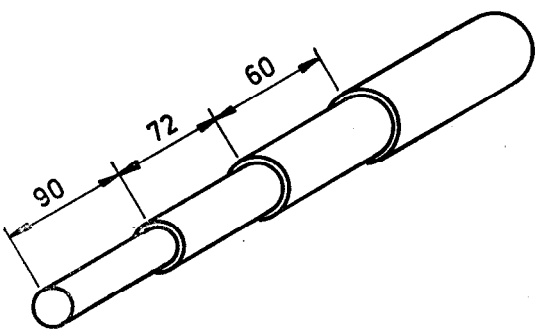

FIG. 1 STEP MACHINED TEST PIECE

5. TEST PROCEDURE

5.1 The test piece shall be examined with the naked eye or with the help of a magnifying glass (maximum magnificatoin 10×).

5.2 To facilitate examination, the test piece may be retained in the lathe, so that it may be rotated. A reference line should be marked along the entire length of the test piece. Similarly, the inclusions counted should also be marked (for example by putting a circle round them) to avoid double counting.

5.3 Special precautions shall be taken when examining, so that only lines relating to non-metallic inclusions are taken into consideration, as machining of the test piece surface may also reveal macroscopic irregularities such as cracks, pipe seams, metallic inclusions, etc.

6. ESTIMATION OF TEST RESULTS

6.1 For each step, the number of inclusions and their lengths shall be determined.

6.2 The distribution of inclusions in terms of their size may be obtained by using the classification given in Table 2.

TABLE 2 DISTRIBUTION OF NON-METALLIC INCLUSIONS BASED ON LENGTH

LENGTH OF THE INCLUSIONS mm	WEIGHT FACTOR	NO. OF INDICATIONS
Over 1 to 2·5	1	N_1
Over 2·5 to 5	2	N_2
Over 5 to 10	4	N_3
Over 10 to 20	8	N_4
Above 20	16	N_5

6.3 Test results may be expressed in terms of frequency and severity value.

6.4 Frequency may be expressed as the total number of indications in a given area. A common area of 100 cm^2 may be taken for denoting the frequency.

6.5 Severity is the weighted value of the indications which may be taken as given in Table 2.

6.6 The severity value is calculated by multiplying the number of indications of a given length with weight factor and adding these results and is expressed as the weighted value per 100 cm^2. Thus for a specimen of total area A cm^2, the severity is expressed as

$$= \frac{(N_1 \times 1 + N_2 \times 2 + N_3 \times 4 + N_4 \times 8 + N_5 \times 16)}{A} \times 100$$